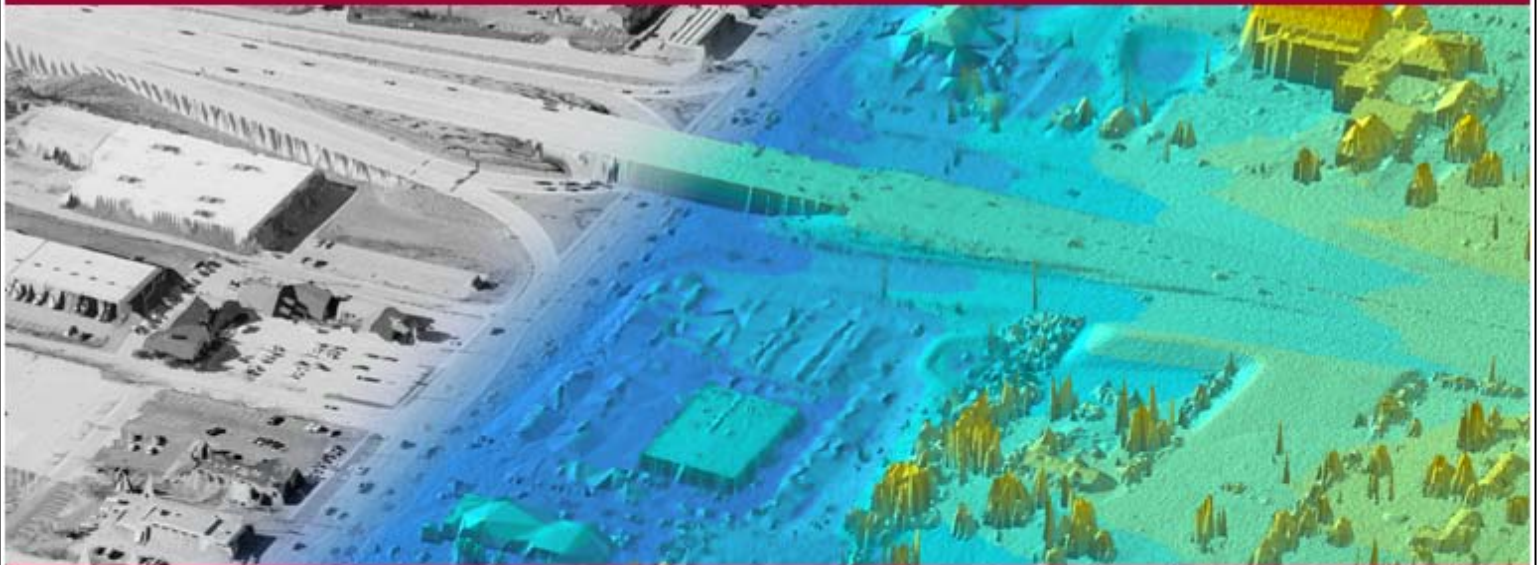


LiDAR ACCURACY REPORT

Project: Boone County, MO LiDAR Project
Report Area: Boone County, MO
Proposal No.: PAQ #48-17OCT14
Contract No.: C213036001-4
Date: 30-September-2015
Submitted by: Wade Williams, Project Manager



Project Overview

Boone County, MO contracted with Surdex Corporation in the fall of 2014 to collect high resolution LiDAR elevation data over Boone County, MO. Processing of the LiDAR data and bare-earth model followed USGS Base LiDAR Specifications V1.0 standards. Surdex tested that the deliverables meet or exceed accuracy as stated in NDEP Guidelines for digital elevation data, Version 1.0 for NSSDA of 95% confidence for 2' contours and ASPRS Class I Standards. Hard surface (bare earth) survey control points were collected by Surdex in order to calibrate the swath LAS data, these values are listed in the table on page 3. In addition independent survey check points were collected on hard surface features, in urban areas, in grass & under trees. The survey check points were compared to both the Classified LAS LiDAR data & bare-earth Imagine DEM and the differences have been outlined on page 6.

In order to meet the project specifications the FVA of bare-earth points for swath and the DEM will meet or exceed 10.0 centimeters RMSEz or less. The RMSEz was calculated as the square root of the average of the set of squared differences between the bare-earth and the survey points collected for the bare-earth (hard surface) features. Also, 95 percent of the feature should be $\leq 1.96 \times \text{RMSEz}$, which equals 19.6 centimeters or less NSSDA. The SVA's for each land cover of grass, trees & urban features will be $\leq 29.4\text{cm}$ @ the 95th percentile. The overall (CVA) vertical accuracy for all classes will be $\leq 29.4\text{cm}$ @ the 95th percentile. The final results for this delivery area are listed on the last page of this report.

Delivery Area

This report covers the collection and processing of LiDAR elevation data over Boone County, MO. The project limits are presented in the graphics below. The project area consisted of approximately 750 square miles of elevation data.

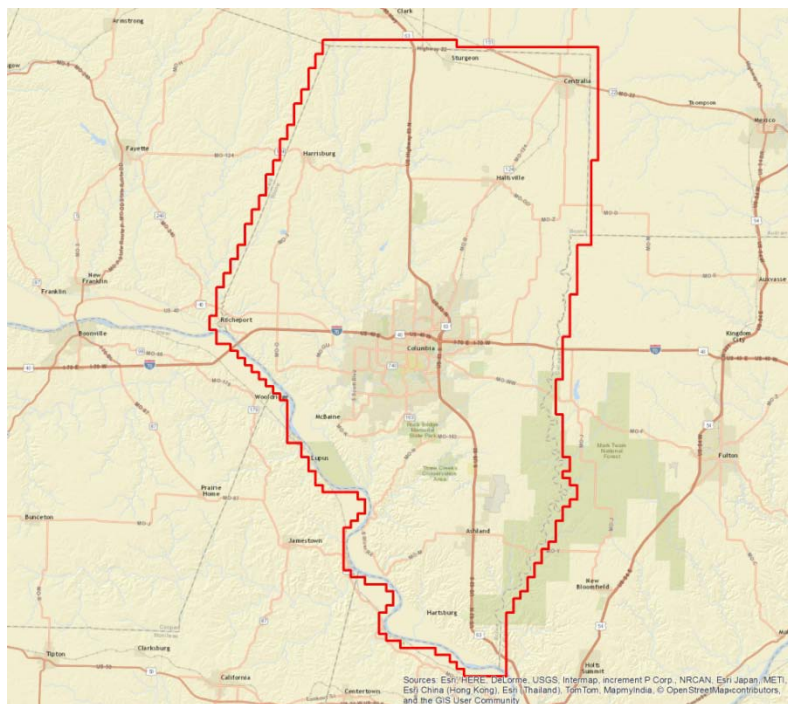


Figure 1 Boone Co. Project Area

LiDAR Data Collection

The LiDAR elevation data for this project was collected with an Leica ALS70 Aerial LiDAR sensor system. The project design called for acquisition of LiDAR data with lines flown north-south. The nominal collection scenario called for the acquisition of nominal point spacing of 0.7 meter on the ground.

Boone Co. Swath LiDAR Control

The field survey control for this delivery consisted of 25 hard surface (bare-earth) control points used for calibrating the unclassified LiDAR swath data. The graphic below presents these control points on the delivery area map.

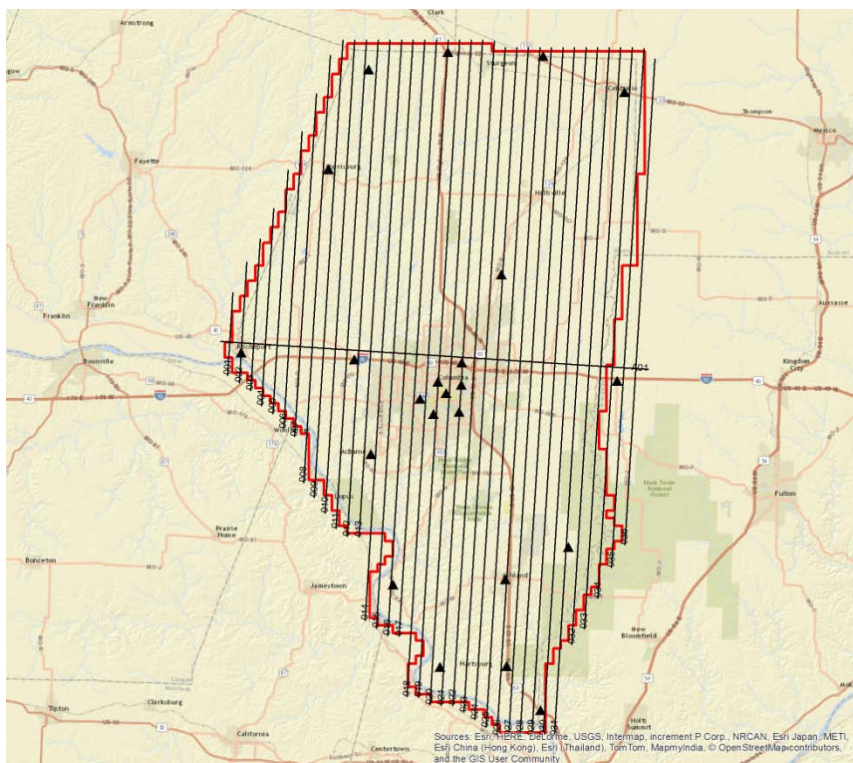


Figure 2 **Boone** Co. Swath LiDAR Control

Swath LiDAR Control Accuracy Results

The table below presents the results of the control accuracy analysis for the Boone Co., AR unclassified swath LAS data. All values are in feet.

Stat	Hard Surface (HS)
Count	25
RMSEz (FVA)	0.209
95% Confidence Level (FVA)	0.410

Boone Co. LiDAR QC Check

An additional set of survey check points were collected for an independent QC of the Classified LAS & Imagine DEM deliverable tiles. The points were collected over the following feature types: 26 hard surface (HS), 25 grass (G) points, 25 tree (TR) & 22 urban (U) points for a total of 98 qc check points. The graphic below presents these QC check points on the delivery area map.

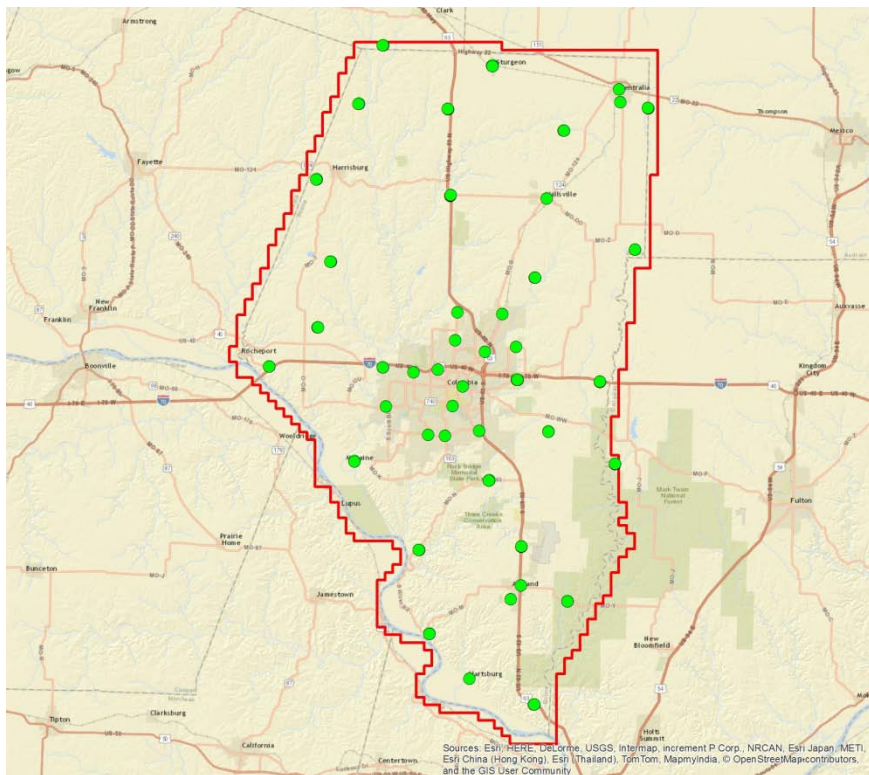


Figure 3 **Boone Co.** LiDAR QC Check

These points consisted of various types of ground cover including asphalt, gravel, short grass, tall grass and trees. Examples to the types of points surveyed are included below.





The required LiDAR elevation data values were derived within ArcGIS from the bare earth LAS files. For each control point location a LiDAR elevation value was derived and exported and the surface value subtracted from the survey elevation. These derived values were imported into Excel and comparisons were performed to generate statistics by ground cover type and for the overall dataset.

Classified LAS QC Accuracy Results

The table below presents the results of the QC accuracy analysis for the Boone Co., MO classified LAS tile data. All values are in feet.

Stat	Overall	Hard Surface (HS)	Grass (G)	Trees (TR)	Urban (U)
Count	98	26	25	25	22
RMSEz (FVA)	0.239	0.211	0.220	0.323	0.167
95% Confidence Level (FVA)	0.469	0.414	0.432	0.634	0.328
95 th Percentile (CVA & SVA)	0.505	0.382	0.442	0.651	0.336

As indicated above the LAS LiDAR surface meets hard surface Fundamental Vertical Accuracy (FVA) project specifications of RMSEz less than or equal to 10.0 cm, with an RMSEz of 6.4 cm. The FVA 95% confidence level of 19.6 cm or less was also met with a value of 12.6 cm.

DEM QC Accuracy Results

The table below presents the results of the QC accuracy analysis for the Boone Co., MO derived bare-earth DEM tile data. All values are in feet.

Stat	Overall	Hard Surface (HS)	Grass (G)	Trees (TR)	Urban (U)
Count	98	26	25	25	22
RMSEz (FVA)	0.234	0.214	0.218	0.310	0.166
95% Confidence Level (FVA)	0.460	0.419	0.428	0.608	0.326
95 th Percentile (CVA & SVA)	0.494	0.393	0.442	0.578	0.313

As indicated above the derived DEM LiDAR surface meets both Supplemental & Consolidated Vertical Accuracy (SVA & CVA) project specifications of 95th Percentile less than or equal to 29.4 cm.